# SYSTEMS, METHODS AND COMPUTER-ACCESSIBLE MEDIUM WHICH PROVIDE MICROSCOPIC IMAGES OF AT LEAST ONE ANATOMICAL STRUCTURE AT A PARTICULAR RESOLUTION

## CROSS-REFERENCE TO RELATED APPLICATION(S)

This application is a continuation application based upon U.S. Continuation patent application Ser. No. 13/042,116 filed on Mar. 7, 2011 issued as U.S. Pat. No. 9,081,148 on Jul. 14, 2015, which claims the benefit of priority from U.S. patent application Ser. Nos. 61/311,171 and 61/311,272, both filed Mar. 5, 2010, the entire disclosures of which are incorporated herein by reference.

## FIELD OF THE DISCLOSURE

The present disclosure relates to exemplary embodiments of imaging systems, apparatus and methods, and more specifically to methods, systems and computer-accessible medium which provide microscopic images of at least one anatomical structure at a particular resolution.

## BACKGROUND INFORMATION

Coronary artery disease (CAD) and its clinical manifestations, including heart attack or acute myocardial infarction (AMI), is the number one cause of mortality in the US, claiming nearly 500,000 lives and costing approximately $400 B per year. Topics relevant to the pathophysiology of CAD, such as the development and progression of coronary atherosclerotic lesions, plaque rupture and coronary thrombosis, and the arterial response to coronary device and pharmacologic therapies are therefore of great significance today. These biological processes can be mediated by molecular and cellular events that occur on a microscopic scale. Certain progress in understanding, diagnosing, and treating CAD has been hindered by the fact that it has been difficult or impossible to interrogate the human coronary wall at cellular-level resolution in vivo.

Over the past decade, intracoronary optical coherence tomography (OCT) has been developed, which is a catheter-based technique that obtains cross-sectional images of reflected light from the coronary wall. Intracoronary OCT has a spatial resolution of 10 μm, which is an order of magnitude better than that of the preceding coronary imaging method, intravascular ultrasound (IVUS). In the parent R01, a second-generation form of OCT has been developed, i.e., termed optical frequency domain imaging (OFDI), that has very high image acquisition rates, making it possible to conduct high-resolution, three-dimensional imaging of the coronary vessels. In addition, a flushing method has been developed which, in combination with the high frame rate of OFDI, can overcome at least some of the obstacles of blood interference with the OCT signal. As a direct result, it may be preferable to perform intracoronary OCT procedures in the clinical setting. Indeed, certain interventional cardiology applications for OCT have emerged, and growing the field exponentially. It is believed that OCT can become a significant imaging modality for guiding coronary interventions worldwide.

Since the technology developed in the parent ROl has been translated and facilitated for a clinical practice through the distribution of commercial OFDI imaging systems, it may be preferable to review macromolecules and cells involved in the pathogenesis of CAD.



For example, a transverse resolution in OCT procedure(s) can be determined by the catheter's focal spot size. To improve the resolution, it is possible to increase the numerical aperture of the lens that focuses light into the sample. This conventional method, however, neglects the intrinsic compromise between transverse resolution and depth of field in cross-sectional OCT images and results in images in which only a narrow depth range is resolved.

An alternative approach can exploit the unique characteristics of Bessel, or "non-diffracting" beams to produce high transverse resolution over enhanced depths-of-field. Bessel beam illumination and detection of light reflected from the sample, however, can suffer from a significant reduction in contrast and detection efficiency. Thus, there may be a need to overcome at least some of the deficiencies associated with the conventional arrangements and methods described above.

As briefly indicated herein above, certain exemplary embodiments of the present disclosure can be associated and/or utilize analysis and manipulation of a coherent transfer function (CTF) of an exemplary OCT system. The current invention is instead based on an analysis and manipulation of the coherent transfer function (CTF) of an OCT system. The CTF can be considered a coherent extension of a modulation transfer function (MTF) and an optical transfer function (OTF). Thus, for example, for non-interferometric systems, the MTF or OTF can be manipulated and utilized according to certain exemplary embodiments. In general, the quality of an optical system can be assessed by comparing its transfer function to that of a diffraction-limited optical system. FIG. **1** shows a graph of coherent transfer functions (CTFs) for, e.g., a diffraction limited 2.5 μm diameter spot and 2.5 μm spot with an extended focal range of 2.0 mm, produced by Bessel beam illumination and detection. As illustrated in FIG. **1**, the transfer function of a Bessel beam illumination and detection **100** can have spatial frequencies that exceed a diffraction-limited system **110**, although it likely sacrifices low- and mid-range spatial frequencies, possibly resulting in reduced contrast and detection sensitivity.

Thus, there may be a need to overcome at least some of the deficiencies associated with the conventional arrangements and methods described above.

## SUMMARY OF EXEMPLARY EMBODIMENTS OF THE DISCLOSURE

To address and/or overcome such deficiencies, one of the objects of the present disclosure is to provide exemplary embodiments of systems, methods and computer-accessible medium according to the present disclosure, which can provide microscopic images of at least one anatomical structure at a particular resolution. Another object of the present disclosure is to overcome a limited depth of focus limitations of conventional Gaussian beam and spatial frequency loss of Bessel beam systems for OCT procedures and/or systems and other forms of extended focal depth imaging.

According to another exemplary embodiment of the present disclosure, more than two imaging channels can illuminate/detect different Bessel and/or Gaussian beams. In yet a further exemplary embodiment, different transfer functions can be illuminated and/or detected. The exemplary combination of images obtained with such additional exemplary beams can facilitate the μOCT CTF to be provided to the diffraction-limited case, and can also facilitate a depth-of-field extension even further.

Accordingly, exemplary embodiments of apparatus, systems and methods can be provided for providing at least one electro-magnetic radiation to at least one sample. For